ILCEP MONOGRAPH 2

QRC

TECHNICAL REPORTS FOR QUICK READER COMPREHENSION

A new technique conserves the time of scientists and engineers in report preparation, assures prompt reporting, and provides reports that meet user needs.

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FOREWORD

This publication is one of a series of monographs issued by the Interlaboratory Committee on Editing and Publishing (ILCEP) of the seven West Coast Navy Laboratories. The committee is composed of the senior publications officers at these laboratories, and functions as a subcommittee of the Interlaboratory Committee on Facilities.

T. J. Mathews
Chairman, Interlaboratory
Committee on Editing
and Publishing

Naval Civil Engineering Laboratory
Ocean W. Lucas

Navy Electronics Laboratory
H. L.Chadbourne
C. M. Johnson

Naval Ordnance Laboratory Corona
Mrs. B. F. Robinson

Naval Ordnance Test Station, China Lake
W. S. Spafford
C. E. Van Hagan

Naval Ordnance Test Station, Pasadena
Catherine C. Campbell

Naval Radiological Defense Laboratory
T. J. Mathews

Pacific Missile Range/Naval Missile Center
K. L. Gardner
D. W. Hill

PREFACE

This paper outlines an approach to reporting research and development work that I have evolved slowly during 20 years' experience in writing and editing technical manuscripts. The approach is unconventional, and doubtless many readers will disagree with it. But I hope that the ideas expressed here at least serve to stimulate interest in some neglected aspects of human communications.

My thanks are due the past and present members of the Interlaboratory Committee on Editing and Publishing for their help and encouragement to me in this work.

I must also express appreciation to three illustrators who have helped me appreciate the value of pictorial communication of technical information. These are John Olsen and John Zane, former heads of the Graphic Design Branch at the Navy Electronics Laboratory, and Barney Reid, the present head of this Branch.

H. L. Chadbourne
U. S. Navy Electronics Laboratory

ABSTRACT

R&D reports can be made to be equally suited to rapid scanning or scholarly reading. This is done by displaying the gist of the material in a series of self-contained informational units, or modules, and by confining detail to the main text. Because the modules are independent of the text, they can be prepared in rough during the task work. The separate module idea also permits the author and a technical editor to collaborate on manuscript preparation so as to take maximum advantage of the talents of each. The reports thus produced conserve writing and reading time, suit the needs of different audiences, and are issued promptly after completion of the work being described. The technique has been proved experimentally.

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By H. L. Chadbourne

INTRODUCTION

Our overworked human communication channels

Dr. Burton W. Adkinson, Head of the Office of Science Information Services, concludes that at present "...the working scientist faces almost insuperable problems in attempting to keep himself informed on what he needs to know."[1]* And certainly the military R&D administrator of today is at least equally handicapped in trying to get the facts he needs to make informed decisions.

Science and technology have had an explosive growth over the past few decades; human communication channels have remained substantially unchanged. The result is that these channels are now grossly overloaded.[2] Unfortunately, very little is being done about this situation.

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* See "Notes" at the end of this paper.

Machines not whole solution

The chief effort now being made to improve human communications is concerned with machinery. Computer techniques are being successfully applied to translating and abstracting documents and for the keeping of library records. Major strides have also been made in increasing the efficiency of printing and duplicating methods. These subjects are important. But they represent only part of the problem. The more fundamental matter of improving the documents that are to be reproduced, abstracted, stored, and retrieved is almost entirely neglected.

Tradition an obstacle

A prime reason for this neglect is blind acceptance of tradition. Reports and papers for example, are still handled today in the manner of the early 1800's, when scientific periodicals first appeared. They belong to the stagecoach - not the space - era. They are manifestly wasteful of preparation time and poorly suited to the needs of present-day readers. Yet the archaic literary form they embody is seldom questioned. Year after year it continues to be perpetuated in textbook[3] and classroom, to be accepted as standard by industry and government.

R&D needed

Perhaps far better solutions are to be found in exotic systems of human communication. Certainly we are not of necessity restricted to writing-reading-talking-listening, all of which are limited not by mental capability but rather by the mechanics of handling language. There are opportunities here for research that might well prove of greater importance than any other undertaken this century.

It is also possible that we can begin now to develop better use of the tools at hand.

This paper outlines one approach to doing this that is being tried experimentally on a small scale at the Navy Electronics Laboratory. The work is still in its early stages; it is described here in the hope that others will be encouraged to try it or - better still - improve on it.

This is a field that has stagnated for too long. There is an urgent need for new attitudes toward it - for new thinking, new ideas. The results could well be of major benefit to science and the whole U. S. defense effort.

TODAY THE TYPICAL U.S. SCIENTIST OR ENGINEER...

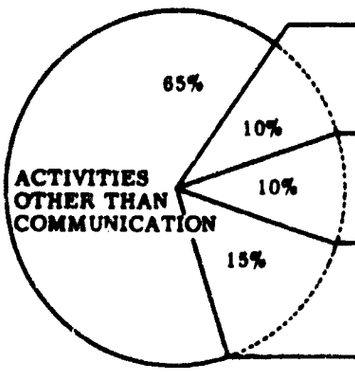
composes English words for use in a report or paper at a net rate of 2 words per minute or less,[12]

comprehends a journal article in his field at a maximum rate of 150 words a minute,[13]

delivers or listens to oral presentations at an optimum rate of 150 words a minute.[13]

Machine methods for document storage and retrieval cannot solve all the problems of communicating R&D work results today. There is also a great need to improve human communication rates. These rates seem absurdly slow for an era in which computers handle the equivalent of an English word in millionths of a second. Either a radically different communications system should be devised or there should be an increase in information yield per unit of writing and reading time spent.

SURVEYS[14] SHOW THAT SCIENTISTS AND ENGINEERS DIVIDE THEIR TIME INTO...



WHEN THE SURVEY PERCENTAGES ARE APPLIED TO THE 925,000 SCIENTISTS AND ENGINEERS IN THE U.S.[15]...

	ALL SCIENTISTS AND ENGINEERS *	R&D - INDUSTRY AND GOVERNMENT *	R&D - GOVERNMENT *
COMPOSING REPORTS AND PAPERS	92,500	33,500	5,750
READING AND SEARCHING LITERATURE	92,500	33,500	5,750
LISTENING AND TALKING AT FORMAL CONFERENCES	138,750	40,250	8,600

* man-years per year

The Quick Reader Comprehension (QRC) method of R&D reporting promises to make both writing and reading more productive. It is potentially capable of saving at least half the manhours that scientists and engineers spend in manuscript preparation, and of increasing greatly the amount of information that can be obtained in a given amount of reading time. Conferences are not discussed in this paper, but undoubtedly they too could be made more efficient through better communication techniques.

AIMS AND STATUS OF NEW TECHNIQUE

New method aids reader and author, speeds reporting

The new method of reporting is known as the Quick Reader Comprehension (or QRC) technique. It provides four major advantages over conventional methods, namely:

1. Gains in readability. The gist of a report is made clear to the person who merely examines it casually. There is no provision for this in conventional reporting.
2. Greater suitability for different audiences. Whereas the usual report is designed only for a subject-field specialist, the new technique takes into account the needs of three types of readers - the specialist, the man in a peripheral field, and the R&D administrator.
3. Savings in scarce manpower. The time that scientists and engineers must spend in report preparation is cut by at least one half.
4. More timely reports. A substantial part of the rough draft is completed while the scientific or technical work is still in progress. This avoids the delays inherent in waiting for the completion of technical work before starting to write.

Limited experimental use; further work planned

So far the QRC technique has been used for three reports published at NEL.[4] The results are encouraging. The engineering time required for manuscript preparation ranged from 50 to 85 per cent less than for comparable reports prepared in the traditional way. Rapid delivery schedules were maintained. Two of the three reports resulted in special letters of commendation from the Bureau of Ships; the third was also well received. And there has been an unusual, continuing demand for additional copies of these publications, so that they have had to be reprinted several times.

Further experiments with the method will be made, and a formal report on the subject will be published in mid-1962.

THE IDEA OF QUICK READER COMPREHENSION

Audiences differ but all need gist

The recipients of an R&D report often differ widely in their subject matter knowledge, use for the material, time for study, and desire for study. They do, however,

have one thing in common. They all need to grasp the main points of the presentation.

If the gist of a report can be made clear to the audience member who has the least interest in its subject matter, least specialized knowledge, and least inclination to read, then the gist will also be clear to other audience members. The common need of all the recipients of the report will have been met. It is then necessary only to provide for the varying requirements of readers for detail.

Design for scanning meets universal need

Quick reader comprehension reports reveal their gist to the person who merely glances hastily through - scans - their pages. All the main points are covered by the title and subtitle, illustrations and their legends, tables, headings, marginalia, or other devices that are suited to scanning. Only these key points are so emphasized. Detail is relegated to the main text. Clutter is avoided.

Effective though not literary

This deliberate design for scanning is the essence of the new technique. All the other benefits of the method are in effect fortunate by-products of this basic idea. The plan entails no sacrifice to the scientific accuracy, completeness, or dignity of the presentation. It does, however, require a considerable departure from the conventional literary form. But R&D reports are not fine literature. Their aim is not to depict character, arouse emotion, instill a mood - it is most often rather to describe a very tangible piece of hardware. If one relinquishes the thought that the only way to communicate is through complete, correct English sentences, then scanning seems attractive. So are other nonliterary communication techniques. (See Appendix A.)

Suits conditions of use

Actually, under today's hectic conditions, many - if not most - supposed readers of reports do scan rather than read the material. This is difficult and often unsatisfactory with documents prepared in the traditional way. Major points are apt to be buried and hence are hard to locate; minor points often stand out so as to give false emphasis.[5] But scanning can be made very efficient if it is considered in the original design. It is one way of conveying a maximum of information in a minimum of time.

Complete detail given in text

The scanning level of presentation in QRC reports is made complete in itself and independent of the main text. The main text is also a complete entity, and is designed for continuous reading. It is the place for detail. Here theory is discussed, proof offered, and other information given in support of the main theme. The treatment can be as scholarly as desired.

There is no cross-referencing between the two levels of presentation, as by the use of figure numbers. However, the headings and marginalia that the scanner sees do serve as signposts that direct him to complete text descriptions. This provides a sort of random access effect. The report holder has an intelligent basis for deciding whether to study or skip any part of the material.

Reader's option - gist or all

The type of presentation provides for the complete range of reader needs. Whereas it is commonly assumed that administrators do not need or wish detail, this is not always true.[6] The real point is that their time should not be wasted. On those occasions when they require supplementary information, they should have ready access to it. They do in QRC reports. Similarly, the subject-field specialist may need information on only a minor topic covered in a report; he should be able to pinpoint this topic in seconds. He can with the QRC technique.

THE QRC MODULE PLAN

View of the scanner

The person who scans a report sees the:

Title and subtitle (if used)
Illustrations and their legends
Tables
Headings
Other "special" matter

If he notes any text passages, they will probably be from the terminal sections (introduction and conclusions) or the abstract.

Information packaged in units

These report fragments can be made meaningful if they are treated as individual, self-contained units. Each unit is designed to give the person who scans parts of the essential information he should have without requiring him to refer to the main text. Taken together, the units cover the principal points of the report. This

conserves the scanner's time and makes his slight effort profitable. He gets basic information almost immediately. He also learns whether the document is important to him and deserves careful reading, or whether it is irrelevant and should be discarded.

No cross-referencing

The individual-unit idea may readily be extended beyond the primary reader (scanner) aids listed above to sections of the main text. Here each section or subsection is confined to discussion of a single topic. There is no cross-referencing. This permits the sectional topics to be prepared at any appropriate time and in no particular order. They are done piecemeal.

Simplified outlining, easy assembly

This approach has several advantages over more usual methods. First, outlining is greatly simplified and relegated to one of the last, rather than one of the first, tasks in reporting. Second, if the units are prepared during the course of the technical work, then large blocks of material are ready for use as soon as the problem has been completed. It is only necessary to arrange these blocks in logical sequence and write transitional sentences or paragraphs. Third, the reader benefits because the author is obliged to stick solidly to one subject at a time.

The illustration, tabular, text, and other units produced in this manner are the reporting equivalent of engineering modules. They are separate; they are functional; and they work and fit together. Their purpose is quick reader comprehension. Therefore, they are called QRC modules.

FUNDAMENTALS OF REPORTING WITH QRC MODULES

The eight basic rules for reporting with QRC modules are as follows:

1. *Give the primary aids - the parts of the report that the scanner notes - precedence over all other material.* Plan and, so far as possible, execute illustration-legend and tabular modules before making an outline or doing any work on the main text.
2. *Use picture-legend sequences whenever they are effective in portraying action* - i.e. in tying together a series of related events. These modules are perhaps the best of all aids to quick comprehension.
3. *Write legends to complement the illustrations*

they accompany. Make them provide the kind of information about the thing illustrated that can best be presented in words; make the photograph or drawing as informative as possible pictorially. Legends should neither restate information that is obvious from the illustration nor be brief, text-dependent identifications. Avoid figure numbers. They promote sloppiness in writing, frustrate the scanner, and cause a major waste of reading time.

4. *Make the main title specific and informative,* with key descriptors placed first. Always use a subtitle. Title-subtitle combinations, like illustration-legend combinations, provide two different and equally valuable impressions of the subject matter almost simultaneously. They also avoid the need for clumsy, excessively long main titles.

5. *Use tables much more extensively than in conventional reports.* They are uniquely capable of presenting certain types of information clearly and rapidly. They reduce the bulk of the text and make for completeness and consistency.

6. *Make headings specific and informative.* Try to plan them for meaning when read together. This makes the highlights and scope of a report evident at a glance. Marginal notes (marginalia) are also often very useful in this respect.

7. *Use imagination.* Invent new kinds of modular presentations when the old ways are inadequate. Example: In a report on a CIC installation, both the spatial relationships and functions of ten work areas were significant. Short text descriptions of the area functions were therefore prepared and arranged typographically to convey the spatial layout.

8. *Last - but most important - take full advantage of editorial and illustration services during the creative phase of reporting.* Do not waste time and effort preparing successive drafts of material and having them reviewed. Give the editor the first rough - or ask him to prepare it.

Requires editors and illustrators

Rule 8 is stressed. Editors and illustrators are needed to make the technique work. It requires writing skill; an up-to-date, broad knowledge of presentation methods; and publishing experience. This is because the particular subject content of each report is made to govern the manner of its preparation. Substance rules form. In conventional R&D reports, on the other hand, content is subordinated and forced to fit specification requirements or a prescribed outline. This is easier, but it is not satisfactory under present conditions.

HOW THE MODULES SAVE SCIENTIFIC AND ENGINEERING TIME

Author and editor efficiently divide work

A major advantage of the QRC modules is the scientific and engineering time they save. The reason is that, because the modules are treated separately, their preparation can be efficiently divided between the scientist or engineer author and the technical editor. The author is no longer obliged to organize and write the complete rough draft. He can prepare as little or as much of the material as seems to be efficient. The editor can do the rest.

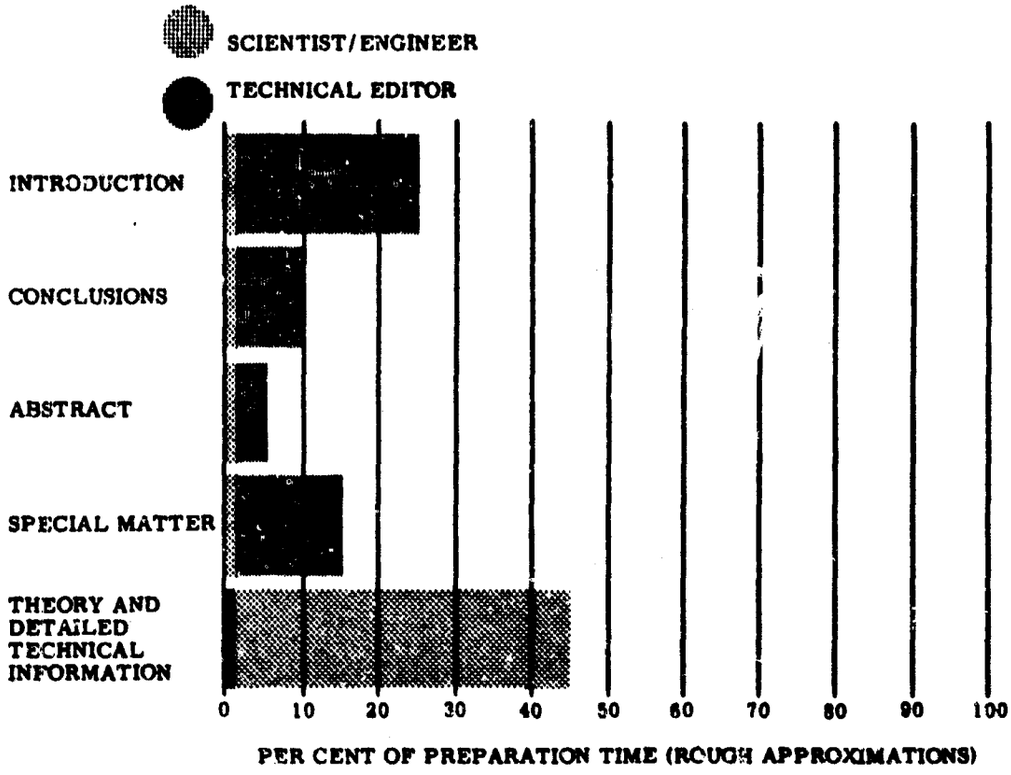
Talents complementary

The author is usually weakest on reporting techniques and strongest on the technical details of the problem on which he has been working. He thus has the greatest trouble and shows the least skill in organizing the material, in handling special matter such as illustrations and tables, and in writing the introduction, conclusions, and abstract. But he is well equipped to write or - preferably - dictate a straightforward description of the work he has accomplished.

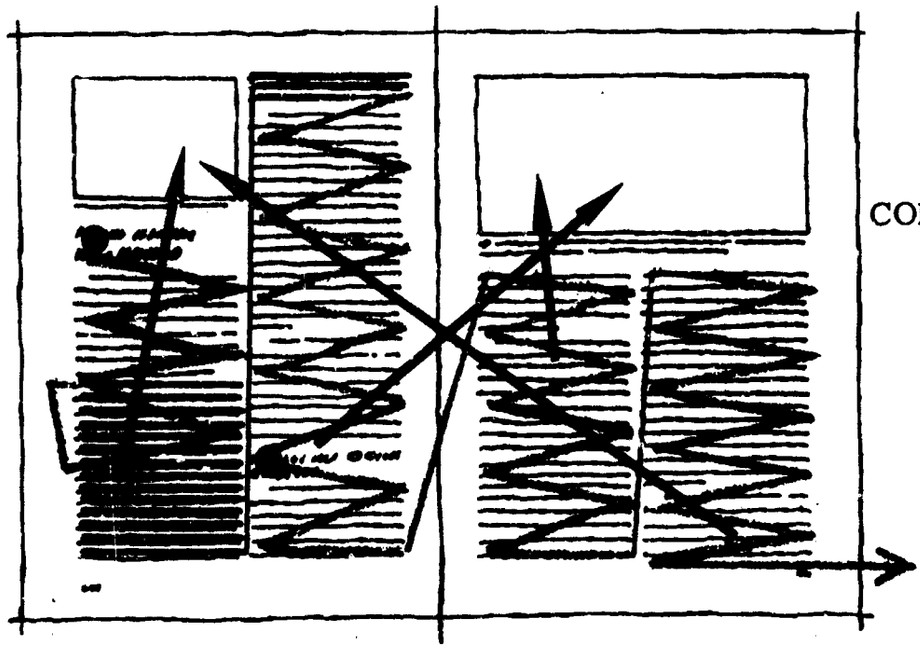
The editor's situation is the opposite. His technical background will seldom be as good as the author's, and he cannot possibly have had the author's intimate acquaintance with the subject matter of the report. But he is professionally adept at organizing bits and pieces of information. In fact, editorial work is largely just this. Also the editor knows presentation techniques, and he can spot the key points to highlight in the terminal sections. Finally, his view is an objective one. He finds it easy to put himself in the position of either the casual scanner or the serious reader.

Editor insures QRC; author handles scientific detail

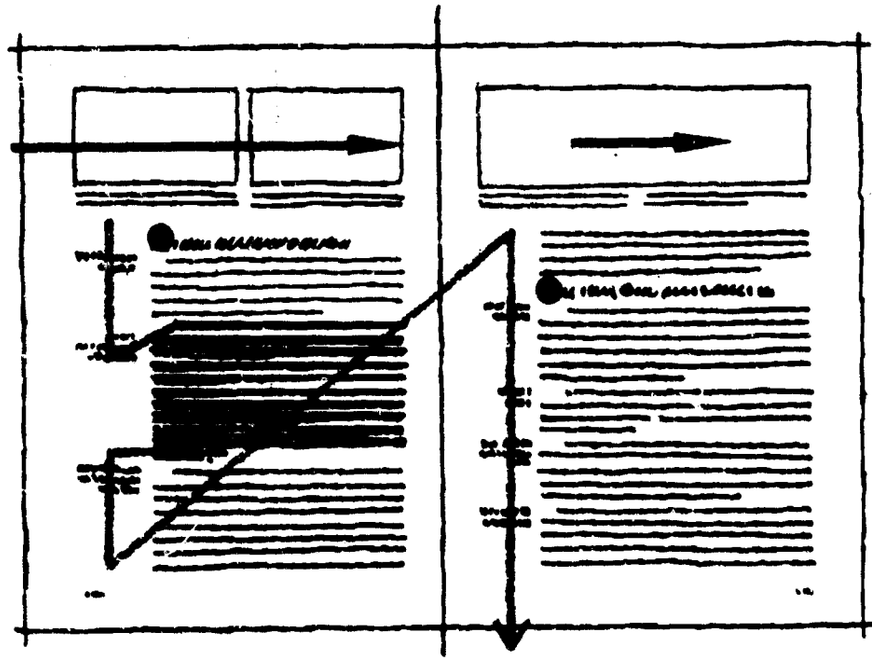
This is an ideal situation. Because of the fortunate work conditions of a modern R&D laboratory (see Appendix B), author and editor can help each other out. The editor normally concentrates on his specialty, the preparation of the primary reader aids. He makes sure that all the key points - and only these points - are properly emphasized for the scanner's benefit. He works with an illustrator in planning pictorial treatment. He writes legends, plans tabular and special modules, and prepares the introduction, conclusions, and abstract. In the meantime the author works exclusively on such scientifically complex text passages as may be necessary. The editor then edits the author's material and organizes the report as a whole.



The scientist or engineer author wastes time when he prepares portions of a report that do not require his specialized education or work experience, but that do demand a high degree of communications skill. The QRC technique prevents this waste. Here the author concentrates on theory and technical detail. The editor handles the introduction (essentially background information); the conclusions and abstract (types of summaries); and the illustrations, tables, and other devices that suit the material for scanning.



CONVENTIONAL



QRC TECHNIQUE

The reader of conventional R&D literature wastes time because he must review all the material to get the information he needs, and because he must continually refer back and forth between illustrations and text. QRC reports present their gist rapidly through illustration-legend modules and other devices that are suited to scanning. They also give a reader the option of locating in seconds detailed text passages on specific topics. This is done by means of suitable headings and marginalia.

Saves scientific or engineering time

The scientific or engineering time that the QRC modules save depends on the difficulty of the subject matter, the make-up of the audience, and the relative communication abilities of author and editor. At one extreme, the author will have to spend only an hour or two discussing the material with the editor; at the other, he will have to do practically all of the work. For most reports, the method will reduce the scientific or engineering efforts required by more than 50 per cent.

Saves total manhours required to report

Although this technique requires more than the usual amount of editorial time, there is still a net saving in over-all cost and time.[7] This is because the editor's experience permits him to write at a faster rate than the typical scientist or engineer.

HOW THE MODULES INSURE PROMPT, EFFECTIVE REPORTING

Plan flexible, not "all-or-nothing"

The QRC module technique can be applied under any circumstances of reporting, and to any degree desired. But it is most effective if the report preparation is carried out at the same time as the scientific or technical work. This assures:

Provides on-the-spot reporting

1. Best results. The modules are prepared during the action period, rather than done from information recalled in retrospect. This gives maximum opportunity to plan photographs, drawings, and other aids so that they emphasize important pieces of information and are free of distracting clutter.

Material handled correctly first time

2. No duplication of effort. Drawings, photographs, and other materials ordered by an author are frequently poorly suited for publication. They have to be either redone, which is expensive and time-consuming, or left as is, which is hard on the reader. But when an editor or illustrator is on hand to coordinate their preparation, they can be executed correctly the first time.

Aids scientist or engineer in task work

3. Better morale. Authors often regard conventional reporting as a nuisance chore to be tackled after everything else has been done. By contrast, the separate modules, which can be constructed at any appropriate time and in any order, may actually help the author with his assigned task.[8]

Ideal models not available

Unfortunately, it was not possible to use this exact plan for the three QRC reports that have so far been produced at NEL. They are not ideal models. General QRC principles were followed, but work did not start at an early point in the technical work and existing photographs were utilized. So a hypothetical example will serve best to illustrate the technique in action.

Hypothetical example shows operation

Assume that a new task has been assigned: Develop an improved handheld sonar to detect and locate objects on the ocean floor.

Reporting begins early in task work

The cognizant engineer immediately calls for an editor. They discuss the problem. It is evident that there have been many different methods of detecting bottomed objects, all of which have different characteristics and performance capabilities. The editor, therefore, suggests a table as the first module to be constructed.

The engineer and the editor rough out this table at their first conference, using a large sheet of crossruled paper. One column at the far right is headed "Remarks"; the other column headings list the performance characteristics about which information is needed.

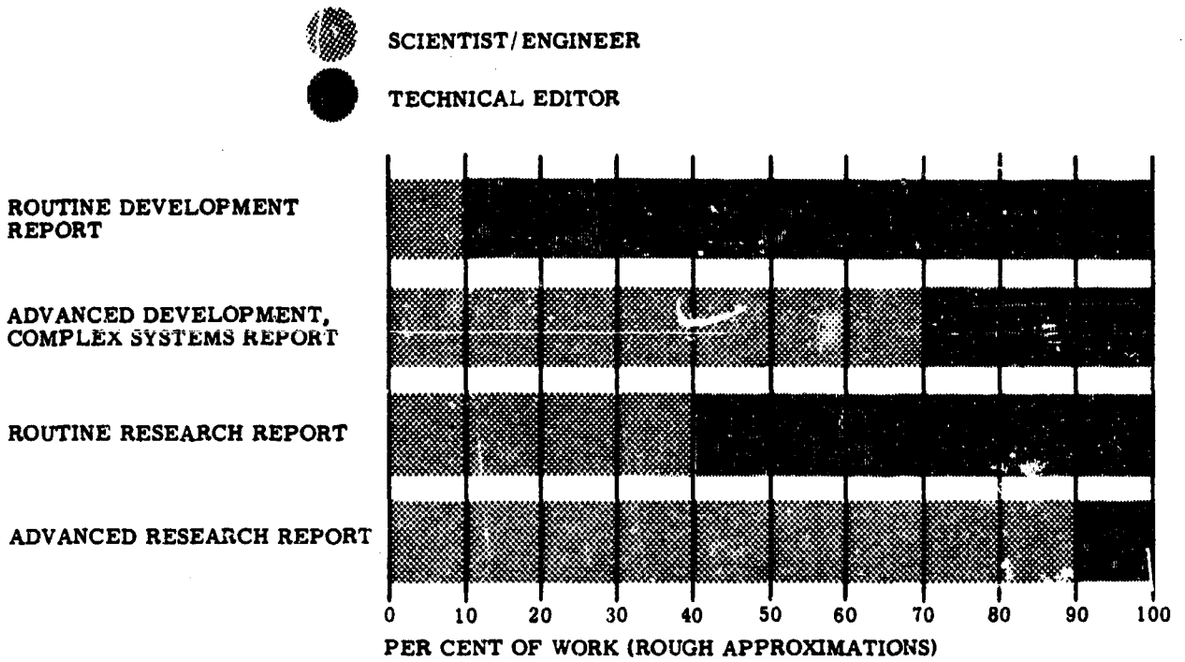
The initial horizontal entry line on the table is devoted to abridged data on the sonar as it is called for in the task assignment. The second entry line is left blank. It will be used for actual results obtained with the sonar when it has been developed. The succeeding lines are filled in with information about other sonars, and ways other than sonar, that have been used to detect bottomed objects.

Modules used for engineering reference

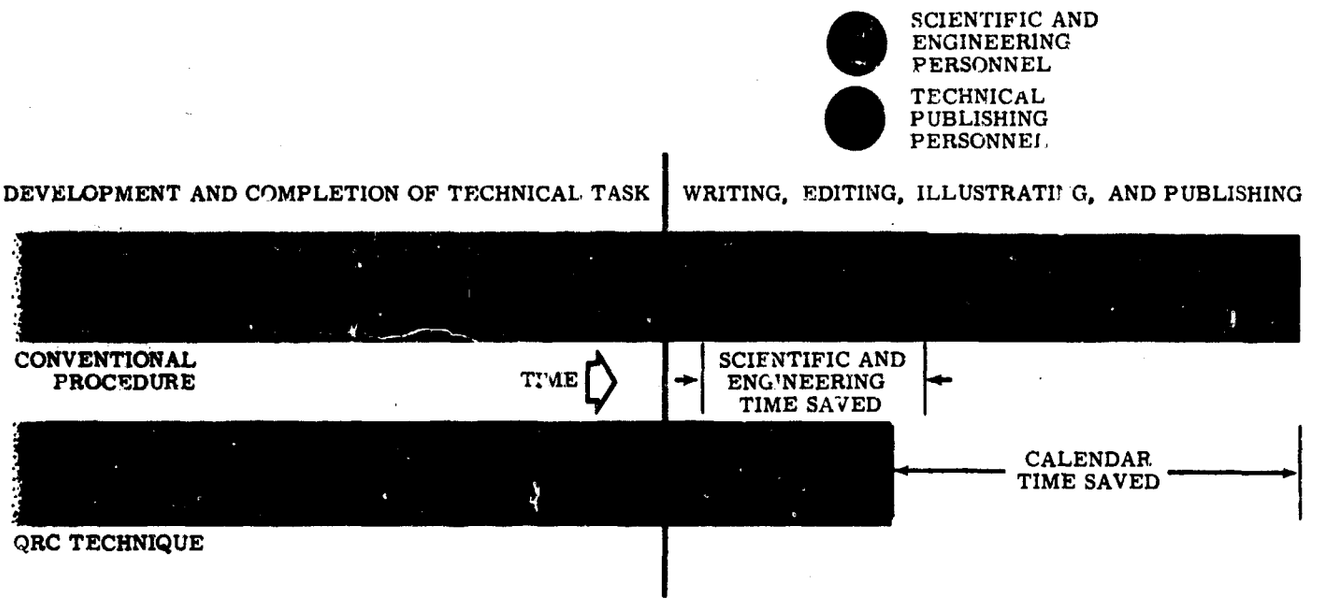
When the table has been completed as fully as possible, the engineer tacks it on his office wall. The data that have been gathered together in disciplined, tabular fashion have helped orient him for the developmental task that lies ahead. Further, a valuable and information-packed module is now nearly ready for use somewhere in the report.

Editor on hand when needed

The engineer next engages in his development work. The editor goes on to another assignment. But when the sonar development has reached a significant phase, the engineer again asks for the editor's help.



The extent of the help in manuscript preparation that can be provided by a technical editor with a good - but not professional - background in science will, of course, vary greatly from report to report. But the QRC technique is completely flexible. Its use can be tailored to the nature of the subject matter being presented. In practically every situation, the method will save large amounts of scientific or engineering time.



The QRC plan also assures the prompt reporting of R&D work achievements. Because these reports are constructed from independent, self-contained informational modules, much of their preparation can be handled while the technical or scientific work is still under way. This on-the-spot handling of information assures optimum design for scanning, prevents duplication of effort, aids the scientist or engineer in his work, and eliminates a profitless loss of time.

Publishing requirements considered throughout problem work

Perhaps a breadboard model has been built. If so, the editor (or illustrator or both) coordinates the photography and the drawing of graphs, schematics, or other illustrative material. These are planned for QRC at the outset. Moreover, the attempt is made to anticipate the probable future course of the development, so that the illustrations will relate logically to each other in the final presentation.

When the illustrations have been prepared, the editor writes their complementary legends and shows them to the engineer for comment. Then these illustration-legend modules are tacked on the engineer's wall for reference.

Collaboration continues throughout problem work

This collaboration is repeated during each significant phase of the development. Finally the point is reached when the new sonar is ready for final tests. This is the period of greatest editor participation. He is continually on hand, working on the report.

Picture-caption sequence tells complete operational story

The tests of this sonar suggest to the editor an illustration-legend sequence. He carefully plans for this module, working out all details in advance with the cognizant engineer, the SCUBA diver who will test the device, the photographers, and the others concerned. The editor is present during the tests. He sees that pictures are taken to show the diver donning the new sonar, wearing it, diving with it, operating it, detecting bottomed objects through its use, and surfacing with it. The editor then writes complementary legends and discusses them with the engineer.

This particular module will, if done properly, convey the whole operational story of the new sonar. It will tell Navy officers practically all they need to know to plan operations around the device and use it. It is truly a major contribution to quick reader comprehension. When it is assembled with the table of comparative data that was first prepared, and with the information provided by the other completed modules, practically the entire report will be done.

Publication quickly follows task completion

Little preparation work remains after this hypothetical development task has been completed. The engineer, in his capacity as author, writes or dictates the detailed technical information that may be needed, such as a description of the operating theory of the electronic circuits in the sonar. At the same time, the editor writes the introduction, the conclusions, and the abstract. Then the

editor edits the author's roughs and arranges all material in suitable order. The final preparation stage before line approval is a conference in which author, editor, and illustrator review all aspects of the presentation and try to improve any modules that seem to be inadequate.

SOLVING PROBLEMS IN QRC REPORTING

Skills must be properly used

The chief hazard to the QRC technique is the possible misuse of editorial services. The scientist or engineer author may fail to call in the editor at appropriate times. Or, in the opposite situation, the author may ask the editor to attend conferences that have no direct bearing on his work, or even to handle irrelevant writing assignments.

Technical information office needed

These conditions can be prevented only by proper use of the talents of both principals. The scientist or engineer should desire the services.[9] And the editor should come from a central technical information office where his work is assigned, followed, and checked by editorial supervisors, and where he can learn improved techniques through association with other editors, illustrators, librarians, photographers, and printing or duplicating personnel.

Recruitment problem exists

A more fundamental problem is; How to recruit the skilled editors that are needed to make the plan work?

If the QRC technique is employed on any large scale, suitable education for it must be provided in college curricula. This suggests an interesting possibility.

Thomas Huxley once said, "Art and science are not two things; they are two sides of the same thing."

Arts and sciences can be fused

Much has been written about the great value of interdisciplinary work in the sciences. The writer believes that equally great rewards may be had from the effective fusion of the arts and the sciences.

Natural combination; possibilities not realized

Human communication is the primary concern of the arts. It is the reason for existence of the writer and artist. They must possess communications skill to succeed in their work. This is not true of the scientist or engineer. There are many highly creative men in these fields who have negligible ability in informing others of their accomplishments. When this is so, the communications expert in writing and illustrating[10] may lend

invaluable aid to the capable, but inarticulate, man in science or engineering.

Even scientists and engineers who possess considerable ability in report preparation waste their education and special talents when they attempt to handle portions of most reports and the whole of some reports. A collaboration of the communications expert and the scientist or engineer is the efficient answer.

Educational requirements must be met

Ideally, the communications expert should be a major in the humanities. He should possess skill at handling language. He should be given, in addition to English, a good grounding in the graphic arts and in other communication techniques that are valuable in reporting scientific information. Additionally, he must acquire an understanding of the sciences and the scientific method - an important minor subject in his education.

Information theory useful as bridge

Dr. P. M. Zall of Los Angeles State College notes that he has been able to interest English teachers in science by introducing them to information theory.[11] This seems an excellent bridge to use in crossing from the arts to the sciences. If the teachers can be interested, so presumably can the students.

Professional-level education mandatory

The education given these communication experts must not be of the trade-school type. Prime requirements are breadth of knowledge, the ability to reason logically, talent in communicating information, and knowledge of communication techniques. At least a 5-year course of instruction seems necessary.

Large-scale use awaits future

A long time will elapse before the quick reader comprehension technique can be put to use on a large scale. Too few qualified people now exist to permit widespread use of the method. If new candidates are to be educated, the time for action is now.

Planning required now

There must be long-term planning, hard work, and a distinct shift in prevailing attitudes toward technical publishing. These are the obstacles. Against them must be weighed the potential benefits of (1) greatly improved dissemination of scientific and technical information, and (2) a major increase in the number of scientists and engineers available for creative work in their fields.

Small-scale use possible today

Small-scale use of the QRC technique is possible today. Many people capable of handling the work are now in technical information groups in industry and government. Fortunately, too, most recent efforts to recruit editors have taken the form of recruiting engineers. There has not been such extensive competition for graduates in English or other branches of the humanities. Yet at least a few of these men and women certainly possess both the requisite communications skill and the scientific background. For these few, there should be considerable appeal in the idea of working in partnership with scientists and engineers for the advancement of science and in support of the U.S. defense effort.

CONCLUSIONS

Time at a premium; talent must be used to advantage

Defense needs are urgent. Scientists, engineers, and R&D administrators are scarce. The country cannot afford extravagance. Therefore, time, talent, and money have to be conserved. This means taking the fullest possible advantage of the services of those who fortunately possess advanced education and work experience in science and technology.

At present there is waste in both the writing and the reading of reports. Through archaic custom, the scientist or engineer is forced to handle not only phases of report preparation that do require his specialized background but also phases that do not. The literature thus produced takes too long to comprehend. And its bulk is so great that an individual can obtain only a tiny sampling of the information he really needs to be effective in his work.

Writing and reading practices must be made more productive. The ultimate solution may lie in exotic systems of human communication. But even today we are not necessarily limited to the stagecoach-era reporting techniques that are commonly used.

One new approach is being tried at the Navy Electronics Laboratory. It is known as the Quick Reader Comprehension (QRC) technique. Compared with conventional reports, it offers the following advantages:

Conventional Reports	Quick Reader Comprehension Reports
Designed for slow, scholarly reading.	Equally adapted to either rapid scanning or scholarly reading.
Gist difficult to extract.	Gist obtainable in seconds.
Designed for audience of peers.	Suits variety of audiences.
Author wastes time in preparing material that does not require his advanced education or work experience - but that does take communication skill.	Preparation efficiently divided between author and technical writer so as to take maximum advantage of the talents of each.
Publication delayed for indeterminate period after problem completion while author writes.	Bulk of material ready at close of problem; assures minimum publishing delay without priority handling or sacrifice to quality.

QRC teamwork approach makes optimum use of individual skills, adds a new dimension to R&D reporting

QRC reports can be produced now on a small scale with available personnel. If the method is widely adopted, however, colleges must provide special curricula for it in their departments of humanities. The 5-year (or longer) course of instruction should include graphic arts as well as English and science. Graduates will be communication experts capable of working with scientists and engineers to gain benefits possible only through the effective fusion of the arts and the sciences.

Human communication problems will not be solved solely through better printing equipment or the use of computers in document storage and retrieval. This present emphasis is misplaced. The greatest challenge lies in improving man's own direct ability to communicate.

APPENDIX A:

WEAKNESSES IN THE LITERARY APPROACH

Reporting is commonly taught as an exercise in English composition rather than in communications skill. Indeed, reports are invariably referred to as being "written," not "prepared." Illustrations and other nonverbal media are considered, but they are treated as though they were necessarily dependent on and subordinate to prose.

In some instances, as in this paper, prose should dominate the presentation. It is not easy to argue in pictures. But many development projects, for example, can be described most effectively if the greater emphasis is given to illustrations. In these instances, the illustrations should be considered before the prose. Such information as they cannot supply should be put in the legends that accompany them or in the main text.

There are probably three reasons for the present concentration on the literary approach. First, in the stagecoach era, from whence we derive our present reporting practices, there was little incentive to communicate rapidly. Second, until recently illustrations in publications were relatively very costly. Third, most of the instruction in reporting today is given by English teachers. These teachers naturally have a love of fine literature which they seek to pass on to their students. Moreover, in their normal reading, English teachers seldom encounter such devices as graphs, tables, equations, and schematics. And, unless they happen to have had special education in science, they may not appreciate the full information content of some of these devices when they do encounter them.

Certainly the people who prepare technical manuscripts should be taught to write well. This instruction is invaluable. The objection is not that it is given, but rather that it is taught as being almost the entire concern.

There is a great need today to extend our concepts of human communication. We need, for instance, a systematized account of communication techniques that can be applied to the reporting of scientific and technical information.

To give an example: consider the electronics schematic. Compare the time it would take to describe, in English prose, the interconnections in a complex circuit versus the much shorter time it would take to sketch the schematic freehand. Yet in each instance we are dealing with the same information from the mind; it is not mental capability that makes the difference in communication time - it is technique.

Consider, too, reading the prose about the circuit interconnections versus reading the schematic. The reader probably could not comprehend a complex circuit from such a description no matter how much time he took, whereas he could grasp all details in seconds with the schematic. Again, we have the same mind and the same information - the difference is in communication technique.

It should be possible to develop generalized descriptions of the kind and rate of information transfer that can be obtained with different methods of human communication. Here the schematic would not be described in terms of electronics. Rather, it would be treated as an approach of known usefulness in a situation where (a) many dissimilar things are used in combination to perform a function, and (b) the information to be communicated is how these things are tied together (related to each other).

The same sort of development could also be applied to various types of tables, graphs, photographs, titles and subtitles, text, and other elements of a report. Then, when the basic information was obtained, means could be devised of improving the communication effectiveness of the different techniques. It might, for example, be possible to add a few conventions - a simple, easy-to-learn "language" - to the representational drawings that are often found in reports so as to give them extra meaning without requiring extra effort or time on the reader's part.

The outcome of this suggested investigation should not be to form specifications or produce rules for reporting. Rather it should be to systematize knowledge about reporting so that the reporter can proceed from an informed basis to exercise skill and creativity. Now, except for the instruction that is given in English composition (usually meager), the author works blindly.

It seems likely that, by perpetuating the stagecoach era philosophy of reporting, we are missing some attractive alternatives. This is the main weakness of the literary approach.

APPENDIX B:
ADVANTAGES OF REPORTING IN AN R&D LABORATORY ENVIRONMENT

The skillful editors of magazines such as the Scientific American and Natural History often use devices to insure quick reader comprehension. They know that the general approach works because they are in touch with their audiences. However, their conditions of operation necessarily prevent them from using the method to its fullest extent.

There are advantages and disadvantages to commercial publishing in comparison with publishing in a modern R&D laboratory. These do not seem to be generally understood, and so will be mentioned here.

The commercial publisher possesses the great advantage of being in an obviously competitive business. He therefore has some excellent criteria on which to judge the success or failure of his efforts. He has month-to-month knowledge of the kind and number of his readers and advertisers. The processes of selection are at work - the readers select and pay for the magazine themselves, and the editors select and pay for the articles they use. There is continuous feedback in the form of letters to the editor. Thus, the publishers are aware of both cause (the magazine) and effect (reader reaction to the magazine).

Publishers in research, development, and production activities lack these criteria. Their publications go to a captive and generally unresponsive audience. They cause no discernible effect. The readers are not out of pocket for the material they receive, nor do they select it, nor are they inclined to write concerning it. Further, the editors have little if any choice of material to publish, and the organizations for which they work are oriented for activities quite different from publishing. These conditions lead to an absence of standards and an ignorance of the results of R&D publishing. They also obscure a large potential advantage that the R&D publisher has over his commercial counterpart.

A modern R&D laboratory actually offers a nearly ideal environment for technical and scientific reporting. Editors, illustrators photographers, librarians, draftsmen, and typists are continuously available while the

events to be reported are happening. They are at the scene of action. They can help authors when such help is most needed - during rather than after manuscript preparation. They can plan QRC modules to maximum advantage, and they can build them into effective reports. By contrast, authors outside R&D establishments seldom have access to publishing services until after their manuscripts have been completed. Author and publisher may be thousands of miles apart. So the commercial editors, illustrators, and others concerned can only "tack" some of the aids to quick reader comprehension onto existing material. This is not the most efficient practice, and it does not yield the best possible results.

Technical communications from R&D organizations can be made to reflect the natural advantages of the R&D work environment.

NOTES

1. Quoted from Committee on Government Operations, United States Senate, "Documentation, Indexing, and Retrieval of Scientific Information," 86th Congress, 2nd Session. Senate, Document No. 113, United States Government Printing Office, Washington, 1960.

2. It has, for example, been estimated that a chemist today who typically devotes 4 hours a week to reading in his field can expect to cover but 1/2 of 1 per cent of the current chemical literature a year. (See Irving Hirsch, William Milwitt, and William J. Oakes, "Increasing the Productivity of Scientists," Harvard Business Review, March-April 1958, p. 66-76.)

3. The writer has surveyed 17 recent books on report writing. While most of these books are well prepared and useful, none seems to suggest truly novel solutions to reporting. Practically the only information these books contain that would greatly surprise an engineer living in, say, 1900 is their descriptions of printing and duplicating processes.

4. BuShips Memorandum Report 445-034 (Confidential), 30 March 1959; NEL Report 945 (Confidential), 18 November 1959; and The Omega Long-Range Navigation System, NEL Report 958, 1 March 1960.

5. Illustrations, of course, inevitably attract attention in a report. Unless they are carefully selected for high information content, they may produce an effect that is quite the opposite of that intended by the QRC technique. It is unfortunately all too common to find in a report a picture of (for example) a quonset hut on a desert. The legend may state, "Figure 5. View of quonset hut in the Mojave desert installed for the tests." Somewhere buried in the text will be found explanatory comments, "Figure 5 shows the desert quonset installation that was used to. . ." This emphasis on information that is easy to visualize without a picture, and this further belaboring of the point in caption and text, waste both key space area and the reader's time.

6. One editorial supervisor determined by a survey that administrators believed they wished only brief digests of information in reports. Yet when this sort of presentation was supplied, they complained of the absence of supporting detail. (Reported by John G. Fawcett, head of publications at Marquardt Aircraft Corporation, in a

talk entitled, "Goals for the Technical Report: What Management Thinks the Sponsoring Agency Wants." Talk given at the 8th Annual Convention, Society of Technical Writers and Publishers, San Francisco, April 1961.)

7. All too frequently it is assumed that the entire cost of a report is represented by the publisher's charges for editorial, illustration, and reproduction service. Other costs are not taken into account because they are hidden. This misleading practice gives rise to the "cheap" reports myth. A so-called cheap report may be one for which publishing charges are only $100 for duplication. Yet $5,000 and a half-manyear of a scientist's time may have been spent on the manuscript before it arrived for publication. Conversely, a report covering the same material would be considered to be "expensive" if it bore $2,000 in technical publishing charges, even though the other costs had been only $500.

8. One reason frequently advanced for having scientists and engineers write their own reports is that the process is said to help them organize their thoughts. Yet normally the reporting does not start until after the problem work has been completed. It seems more efficient to have thought organization occur during the scientific or technical task rather than following it.

9. R&D organizations that do offer competent help in manuscript preparation find that the service is welcomed by the large majority of scientists and engineers. This has been stated to the writer by a number of technical information supervisors in government and industry, and it agrees with his own experience.

10. The writer is indebted to John Zane, formerly of the Navy Electronics Laboratory and now advertising manager of the Cubic Corporation, for this concept of the communications expert.

11. From a discussion by Dr. P. M. Zall at the IRE Professional Group on Engineering Writing and Speech (PGEWS) symposium, Los Angeles, 1959.

12. Interpolated from "Guide for Writing Reports," Electronics, July 25, 1958, p. 18. Also, derived from information from Navy laboratories on the writing rates of technical writers (who certainly write no more slowly than scientists and engineers) and personal observation. It is difficult to obtain information on this subject because writing time is generally buried in over-all problem charges.

13. From talk by Dr. Milton Goldstein given at the Seventh Annual National Convention, STWE Meeting Jointly with TPS, Chicago, 1960, "The Human Factor in Communication - A Research Study."

14. From "Bibliography of the Use of Scientific Literature and Reference Services as Revealed by Studies Directed to the Scientists" (actually a summary) (in International Conference on Scientific Information, Washington, D. C., 1958. Proceedings, v. 1, p. 21-42, National Academy of Sciences-National Research Council, Washington, D. C.)

15. From "Statistical Abstract of the United States: U. S. Bureau of the Census," 1960 (81st Edition), Washington, D. C., 1960.

Additional copies of this monograph can be obtained by addressing requests to Commanding Officer and Director (Code 2460), U. S. Navy Electronics Laboratory, San Diego 52, California.